Focal Liver Lesions: Characterization with MDCT

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CT: Principle

• Ability to detect a liver lesion depends upon:
  • Relationship between size and section thickness
  • Background organ attenuation: overall and regional
  • Contrast difference between liver and lesion

• Ability to characterize depends upon
  • Presence of calcifications, necrosis, cystic areas
  • Morphologic features: borders, internal architecture, scar
  • Enhancement pattern: type, intensity, timing
  • Associated findings: e.g., cirrhosis
Lung Ca, Staging CT

Mets, not visible due to fatty liver
Morphological Features

Cholangiocarcinoma
Central Scar: Primary Liver Tumor

- Ca Fibrolamellar
- Ca Hepatocellular
- Hemangioma
Attenuation

Lipoma in TS
Intravenous Contrast

- Purpose: demonstrate different perfusion characteristics of liver and lesion
- Differential delivery of contrast between lesion and liver: time or intensity
- Contrast variables:
  - Injection rate
  - Acquisition timing: multi-phasic scans, arterial
  - Total load (volume, I concentration)
Liver CT Technique

• Goal: Maximize attenuation difference between normal liver and lesion

• Hepatic parenchymal enhancement depends upon total load of contrast

• 35 to 45 g I: 100 mL [350] to 150 mL [300]

• 4 to 5 mL/sec

• MDCT: 40-64 channels, 1-1.25 mm thickness, 0.5 sec scan rotation, scan time 3-4 sec / phase
Time-attenuation curve: hypovascular lesion

- Aorta
- Hepatic Parenchyma
- Hypovascular Lesion
Time-attenuation curve: Hypovascular lesion

HU

Sec

Hepatic Parenchyma

Hypovascular Lesion
Time-attenuation curve: Hypervascular lesion

- Aorta
- Hepatic parenchyma
- Hypervascular lesion

HU vs. Sec (seconds)
Focal Nodular Hyperplasia
Unenhanced CT

• Necessary for:
  • Demonstrating Ca++
  • Necrosis
  • Cystic Degeneration
  • Diffuse diseases that may affect attenuation of background liver parenchyma (fat, iron)
  • Detection of associated hemorrhage
Diagnosis??

HAP

PVP

I-
Simple Cyst! ...in a fatty liver
Characterization: Phases

- Non-Contrast
- Hepatic Arterial
- Portal Venous
- Delayed (5, 10 or 15 minutes): occasionally
  - 5 minutes: cyst vs. metastasis
  - 10 – 15 minutes: cholangiocarcinoma
  - NO hemangioma
Intrahepatic Cholangiocarcinoma

15 Min
Classic Hemangioma: No delayed Images

I-
PVP
15 Min
Characterization: Main Purpose

- Insignificant lesions:
  - Focal nodular hyperplasia
  - Hemangioma
  - Focal fatty infiltration
  - Cysts

- Significant lesions:
  - Metastasis
  - Hepatocellular Carcinoma
  - Adenoma
  - Cholangiocarcinoma
Cyst...Not so Simple

Hydatid Cyst
Biliary Hamartomas
Abscess: Hyperemia
Hemangiomas: Importance

- Most common benign hepatic neoplasm
- Reported prevalence in the general population: 5 – 20%
- Diagnosis heavily reliant on imaging studies
- Confident and accurate diagnosis avoids unnecessary tests and anxiety
Histopathology

- Vascular spaces lined by endothelium and separated by connective tissue
- Variable
  - fibrosis
  - cystic change
  - hemorrhage
  - calcification
“Classic” Appearance

- Itai Y et al, Radiology 1980
- 12 patients, 19 lesions (2-10 cm)
- “Dense accumulations of rapidly injected contrast material in early post contrast scans”
- 10 mm thick slices, drip infusion, incremental scans with limited coverage
“Classic”

- Peripheral, discontinuous, nodules
- Nodules iso-attenuating with aorta
- Progressive centripetal enhancement
Common Clinical Scenarios

• Characterization of focal liver lesion found incidentally
• Exponential increase in use of MDCT: increase in hemangiomas brought to clinical attention
• Multi-phasic CT commonly shows small avidly-enhancing nodules in HAP images
• Familiarity with typical AND atypical patterns of hemangiomas on MDCT: imperative
“Atypical” Enhancement Patterns

- Complete, homogeneous and avid early arterial enhancement (“flash-filling”)
  - usually matches attenuation of the aorta
- Central nodular enhancement:
  - with or without centrifugal progression
- Single or dominant nodule
- “Bright dot” enhancement
- Annular (continuous) enhancement
- No discernible enhancement
“Flash-Filling”
Central Enhancement
Annular Enhancement

Hemangioma

Mets

HCC
Factors Accounting for Enhancement Pattern

- Multiple:
  - image acquisition variables
  - patient variables: weight, hemodynamic status/cardiac output and hydration status
  - liver status: steatosis and fibrosis
  - phase of hepatic enhancement, injection rate, iodine content in IV contrast
  - morphological and histological features: size, vascularity, fibrosis and internal architecture
Effect of Technique

PVP, 8 mm

HAP, 1.25 mm

MR
Importance of Timing